Washington State DOT’s Vulnerability Assessment: Asking the “Climate Question”

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Washington Climate Change Impacts Assessment

- Funded by the Washington State Legislature
- Governor and the state legislature directed state agencies to use this science (Executive Order 09-05)
- Published in 2009
- Comprehensive report on climate change impacts in Washington
- Detailed data and technical support available
Goal: Preserve assets in a changing environment

• Apply an asset management approach
  – Be ready for severe weather events and long-term changes in site conditions
  – Inform long-term decisions
  – Build resilience where possible

• Conduct a statewide vulnerability assessment
  – Test-drive the FHWA model
  – Understand and communicate current science
  – Scope: Consider impacts on our all WSDOT assets (Highways, Ferries, State-owned Rail and Airports)
## Step 1 – How critical is the asset?

### WSDOT Methodology

<table>
<thead>
<tr>
<th>Very low to low</th>
<th>Moderate</th>
<th>Critical to Very Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Criticality of asset

Notice that along with the qualitative terms there is an associated scale of 1 to 10, this is to serve as a facilitation tool for some people who may find it useful to think in terms of a numerical scale - although the scoring by each individual is of course subjective. The scale is a generic scale of criticality where “1” is very low (least critical) and “10” is very critical.

### Typically involves:

- **Very low to low**
  - non-NHS
  - low AADT
  - alternate routes available

- **Moderate**
  - some-NHS
  - non-NHS
  - low to medium AADT
  - serves as an alternative for other state routes

- **Critical to Very Critical**
  - Interstate
  - Lifeline
  - some NHS
  - sole access
  - no alternate routes
Complete catastrophic failure
Results in total loss or ruin of asset. Asset may be available for limited use after at least 60 days and would require major repair or rebuild over extended period of time. “Complete and/or catastrophic failure” typically involves:
- Immediate road closure;
- Disruptions to travel;
- Vehicles forced to re-route to other roads;
- Reduced commerce in affected areas;
- Reduces or eliminates access to some destinations;
- May sever some utilities located within right-of-way;
- May damage drainage conveyance or storage systems.

Temporary operational failure
Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days and may have immediate limited use still available.
“Temporary Operational Failure” typically involves:
- Temporary road closure, hours to weeks;
- Reduced access to destinations served by the asset;
- Stranded vehicles;
- Possible temporary utility failures.

Reduced capacity
Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available. “Reduced capacity” typically involves:
- Less convenient travel;
- Occasional/ brief lane closures, but roads remain open;
- A few vehicles may move to alternate routes;

Figure 2.1 Photo depictions of qualitatively assessed climate change consequences
Step 2: What are the Climate Threats?

- Began with climate change forecast from UW Climate Impacts Group

- Talked about observed changes and extreme events with a variety of disciplines including: Maintenance, hydraulics, bridge, geotechnical, materials, environmental staff, etc

- Key Questions:
  - “What keeps you up at night?”
  - “What if it gets worse (given the scenario)?”
  - “How resilient is our existing system?”

- WSDOT’s internal experts ranked all WSDOT assets
Workshops: How might climate impact assets?

<table>
<thead>
<tr>
<th>Primary climate drivers</th>
<th>Can lead to impacts on...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Expansion joints, pavement, rail tracks, construction periods, habitat projects, electrical equipment</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Flooding of surface roads &amp; tunnels, road washout, pump capacity, drainage</td>
</tr>
<tr>
<td>Hydrologic shifts</td>
<td>Soil instability, water supply, bridge and road support structures</td>
</tr>
<tr>
<td>Sea level rise, storm surge</td>
<td>Coastal erosion, coastal and upriver flooding, bridge footings, drainage, roadside stability, salt / corrosion</td>
</tr>
</tbody>
</table>
Changes in Flood Risks

• Flooding in western Washington has changed in magnitude and frequency due to the combined effects of warming, increasingly intense winter storms and sedimentation.

• In other parts of the State, changes in flooding are mixed, and in eastern Washington projected reductions in spring flood risk are common due to loss of spring snow cover.

Erosion and Scour

Scour and damage to structures - Just off SR410 White River
Rock and Mudslides

US 2
Mean Sea Level Trends

Seattle, WA  2.06 +/- 0.17 mmyr

Source: NOAA

Washington State Department of Transportation
Bridge Engineering Information System (BEIS)

This site provides access to inventory data, plans, rating reports, inspection reports, photographs, and related files for bridge structures in the WSDOT bridge inventory. This inventory of bridge structures includes some locally owned agency structures.

There are over 8,500 bridge structures in this database, therefore it is necessary to provide information about the structures of interest to reduce the list to a displayable level. Please provide one or more pieces of information about the structure(s) you are interested in:

Structure ID 
Bridge Number 
County 
Contract Number  
Route 
Milepost Range

Search  Show Map  Reset  Hide Search Criteria
# Mud Bay Bridge (101/508E)

## Bridge Information

- **Bridge Number**: 101/508E
- **Structure Identifier**: 0005677/A
- **Location**: 1.3 S JCT SR 8
- **Route**: 00101
- **Mile Post**: 362.83
- **Facilities Carried**: US 101
- **Region**: OL
- **Owner**: Washington State

## Structure Data

- **Structure Type**: CS
- **Operating Rating Tons**: 36
- **Inventory Rating Tons**: 34
- **Min Over Deck**: 99.99”
- **Min Under Bridge**: 0”
- **Sufficiency Rating**: 80.42
- **Year Built**: 1958
- **Year Rebuilt**: N/A

## Inspections Performed

<table>
<thead>
<tr>
<th>Report Type</th>
<th>Inspe Date</th>
<th>Inspe Freq</th>
<th>Inspe Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>2010-05-12</td>
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<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>2010-05-12</td>
<td>72</td>
<td></td>
</tr>
</tbody>
</table>

## MUD BAY Image

![Mud Bay Bridge Image](image-url)
Mud Bay Bridge (101/508E) As-Builts
Mud Bay Bridge (101/508E)
Statewide Results

Assumed 2 foot sea level rise
What did we find?

- Intensifies known threats
- Reinforces value of our current maintenance and retrofit programs
- Some surprises
- Unique way to capture knowledge of field staff
Timeline of WSDOT’s Assessment

- **2011**
  - Oct.: FHWA Grant
  - Jan.: Workshops across the state to evaluate all WSDOT Assets

- **2012**
  - Nov.: Map and communicate results
  - Jan.: Direction & Guidance

- **2013**
  - May: Integrate into asset management paths
  - Sept.: Begin Skagit Pilot July 1st
  - Jan.: Workshops across the state to evaluate all WSDOT Assets
  - June: FHWA Phase II Pilot

**Workshops across the state to evaluate all WSDOT Assets**

**Map and communicate results**

**Direction & Guidance**

**Integrate into asset management paths**
2011 WSDOT Climate Impacts Vulnerability Assessment Results in Skagit Basin

Climate Impacts Vulnerability Results
- High Vulnerability
- Moderate Vulnerability
- Low Vulnerability
- Low Vulnerability State Ferry
- Flood Zone (100-year)

FOR PLANNING ONLY
Not suitable for site specific use. Depicts results of WSDOT Climate Impacts Vulnerability Assessment (2011)
2013 Skagit Project Team Members

- **WSDOT Project Team Members**
  - Region Planning
  - HQ – Technical Experts
    - Hydraulics, hydrology, stormwater
    - Emergency preparedness and response
  - Climate Change Steering Committee
    - Sustainable Transportation staff from Environment, Design, Public Transportation
- **US Army Corps of Engineers**
- **County Partners**
Questions?

For more information: http://www.wsdot.wa.gov/SustainableTransportation/adapting.htm

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